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The University of Wisconsin

Third Report

OF THE

Pharmaceutical Experiment Station

FOR THE FISCAL YEARS

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CONTENTS

	Page
Report of the Director	5
Legislative Appropriation	6
Endowment of Research Fund	8
Cooperation	10
With the Federal Government	10
Fritzsche Brothers Fellowship	10
Wisconsin Conservation Commission	10
College of Agriculture	10
Milwaukee Public Museum	11
Dissemination of Information	11
Relative to Pharmacists	12
With Store Room "C"	12
Economic Experiments	12
Belladonna	13
Peppermint	13
War Work	15
Monarda and Thymol	15
Plant Breeding	18
Medicinal Plants and Designs	18
Publications	19
Report of the Pharmacognosist	20
Report of the work of the Pharmacist	29

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REPORT OF THE DIRECTOR

The cultivation of medicinal plants for other than teaching purposes was begun in the spring of 1908. Since then, and more particularly since the beginning of the war, which revealed our dependence on European countries for many important vegetable drugs as well as synthetic remedies, other universities have begun the cultivation of medicinal plants with reference to the economic aspect thereof. Moreover, the cultivation of medicinal plants on a commercial scale has been successfully undertaken by pharmaceutical manufacturers and others.

Of greater significance, however, is the endorsement given the establishment of the Wisconsin Pharmaceutical Experiment Station on part of the Legislature in 1913, by the National Association of Retail Druggists at its Cleveland meeting, September 1917. The resolution adopted by this organization, which represents the larger part of the retail druggists of all of the states of the Union, reads as follows:

> That this association go on record in favor of the establishment of a pharmacal experiment staton in every state of the union and the support at least in part, of such stations by the federal government for the benefit of pharmacy in general and the highly important vegetable materia medica in particular.[1]

So much for the future prospects of the general development of the situation in which the Wisconsin Pharmaceutical Experiment Station has been the pioneer. As to the special situation in Wisconsin, two aspects of greatest importance should be pointed out. The first of these has to do with the increased opportunities for service made possible by the last legislature. The second of these deals with the beginning, though small, of the establishment of an endowment which ultimately is to place pharmaceutical research at the University on a sound footing.

[1]N. A. R. D. *Journal*, Sept. 27, 1917, pp. 1214 and 1246.

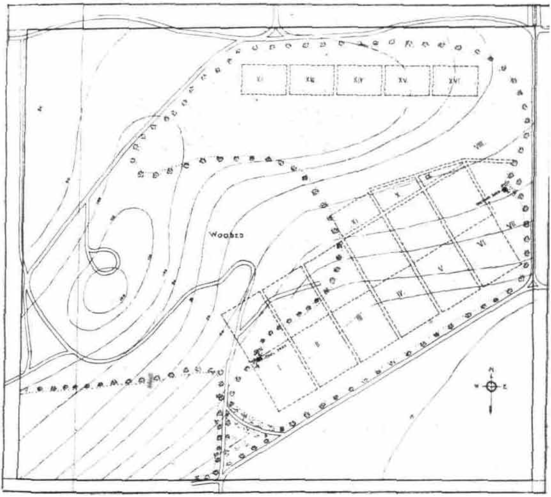
LEGISLATIVE APPROPRIATION

At the urgent request of the Office of Drug-Plant and Poisonous-Plant Investigations at Washington to try out at least some of the experiments in the cultivation of medicinal plants on an economic scale, and for the purpose of contributing as much as possible to relieve the present shortage of important vegetable drugs, the last legislature increased the annual income of the Station from $2500 to $5000. This improvement in the budget made it possible to enlarge the Pharmaceutical Garden. Hence, the former site on Camp Randall, which is gradually being developed into a large athletic field, was abandoned and the tract of land northwest of University bay, known as the Olin forty, was chosen as a site for future developments. An agreement reached between the Business Manager of the University, the Director of the Agricultural Experiment Station, and the Director of the Pharmaceutical Experiment Station, approved by the Board of Regents, made it possible to begin work on the new site in the spring of 1917. Extensions were made in the fall of the same year and in the spring of 1918 the balance of the material was moved from the old garden to the new.

The site is most beautiful, overlooking the bay toward the University and the Capitol. It affords an extensive southern slope, also a gentle northern slope from the top of the hill to the north border of the section. It includes a wooded area as well as several large spaces favorable to cultivation. Bounded on two sides by university drives, its borders are picturesque, affording opportunities for landscape gardening with native medicinal plants. Hence, in addition to its being a beautiful spot, it has all the desirable possibilities for cultivation including those of natural shade.

With the limited budget of the Station, and with the difficulty to obtain necessary help, only a beginning has thus far been made in the new garden. However, several plants have now been cultivated for the first time on an economic or semi-economic scale and the lessons already learned have been of the greatest practical importance. A small beginning has also been made to bring in native medicinal plants, especially such as grow under partial shade as is afforded by the beautiful grove of native trees.

The two garden houses have been moved from Camp Randall and have been given a setting among clusters of spruce trees that offers an idea of the possibilities of effective construction for the future. A well has been drilled to supply the necessary water. Temporary cold frames and hotbeds have been con-



WISCONSIN PHARMACEUTICAL GARDEN

Cooperative enterprise

between

Office Drug-Plant and Poisonous-Plant Investigations. Bureau of Plant Industry, U. S. Department of Agriculture.

Pharmaceutical Experiment Station, Department of Pharmacy, The University of Wisconsin.

structed. Surface drainage had to be taken care of and has led to a beginning in the effective planting of the steep part of the hill. All in all, the progress made during the present biennium, whether viewed from the point of moving the garden, or from that of improvement, be it the eradication of weeds or the re-

moval of boulders, has been so encouraging that the garden staff looks hopefully into the future. The possibilities of doing good in the way of producing much needed medicinal drugs as well as those of beautifying a spot already beautiful are great indeed.

TOOL SHED

ENDOWMENT OF RESEARCH FUND

The second important step taken during the biennium under consideration, to which mere mention has already been made, is the establishment of a permanent research fund. At the time when the pharmaceutical alumni and others discussed the introduction of a bill to establish this Station, they also discussed the possibilities of ultimately providing the Station with funds other than those appropriated by the legislature, hence supplementing state and national aid.

Thanks to an offer of $500 for a fellowship, made by the Kremers-Urban Co., pharmaceutical chemists of Milwaukee, two years ago, a beginning was made in this direction. Their consent to use the amount as an initial subscription to a permanent fund made it possible to supplement this sum with a like amount.

Hence, at Commencement 1917, the first thousand dollars were turned over to the Board of Regents. The gift was accompanied by the following letter of transmittal which specifies the broad lines along which this fund is to be administered by the Board of Regents through future generations of pharmaceutical investigators for the benefit of the state and the pharmaceutical profession everywhere:

> Appreciating that the professional standing of the pharmacist depends as largely upon the advancement of the science and art of pharmacy as upon the services which he renders more directly to society, the pharmaceutical alumni of the University of Wisconsin have decided to raise a research fund to be administered by the Board of Regents. While it is hoped that the fund to be raised will assist in facilitating research in the immediate future, it is the wish of the subscribers that the fund be so administered that its usefulness will increase with the coming years. In order to accomplish this end, one-half of the income is each year to be added to the principal, the other half is to be spent for pharmaceutical research in the broadest sense of the term as recommended by the pharmaceutical faculty and approved by the Board of Regents. In order that the greatest good may come to pharmacy and through the profession of pharmacy to society, the present pharmaceutical alumni invite the participation of other Wisconsin pharmacists as well as of future alumni in the furtherance of this cause, which, more than anything else, will unquestionably assist in giving to pharmacy that standing which so important a calling should enjoy and maintain.

Thanks to the generosity of Regent A. J. Horlick of Racine, the first contribution was supplemented by a second gift of one thousand dollars at Commencement 1918. That this fund may increase materially as years go on and that it may ultimately serve the purpose of placing pharmaceutical research at Wisconsin on such a footing that its benefits may be felt throughout the state is the expressed hope of those who have begun this movement for a better day in professional pharmacy.

COOPERATION

With the Federal Government.—The statute establishing the Station directs it to cooperate with the Bureau of Plant Industry at Washington, which cooperation has continued, as heretofore, through the Office of Drug-Plant and Poisonous-Plant Investigations of which Dr. W. W. Stockberger is in charge. However, owing to the necessities of the war situation, the Government Expert, Mr. Norbert R. Mueller, who was stationed in Madison during the summer of 1917, had to be sent to the South and West for the season of 1918. The Washington office, therefore, increased its financial contribution for garden help. The Station, in turn, conducted a number of experiments for the federal bureau and placed all of the results of the Pharmaceutical Garden at the disposal of the national government.

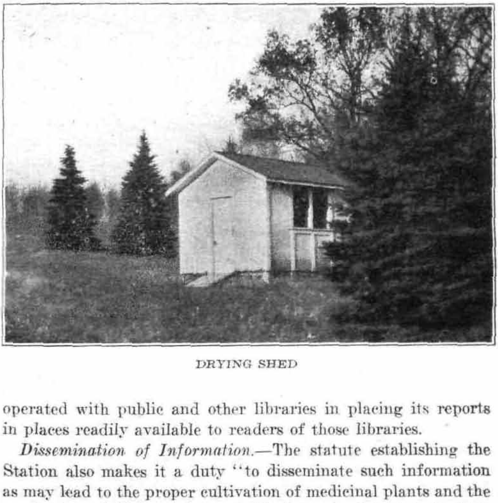
Fritzsche Bros. Fellowship.—That the work of the Station is being appreciated by persons outside of the State of Wisconsin has been demonstrated in a variety of ways, but by none in a more gratifying manner than by the firm of Fritzsche Bros., dealers in volatile oils, in New York City. In order to stimulate the activities of the Station in its researches on *Monarda punctata* L. with the hope of making this thymol-producing plant an economic factor in the manufacture of so important an antiseptic, this firm established a fellowship of $500 per annum for the academic years 1917–18 and 1918–19. A special report on the results of the investigations thus made possible is in course of preparation.

Wisconsin Conservation Commission.—Thanks to the cooperation of this Commission, the Pharmacognosist of the Station was permitted to collect one hundred plants of *Aspidium marginale* Swz. on the Devil's Lake Reservation and to transfer them to the natural shade of the new Pharmaceutical Garden. Hence a beginning has been made in the cultivation of an important anthelmintic, the commercial drug of which is frequently valueless therapeutically because of irrational treatment in curing and storage.

College of Agriculture.—As in the past this college of the University has proven very helpful in a variety of ways. The farm superintendent, as well as the departments of Experimental

Breeding, Horticulture, Plant Pathology and Entomology have cooperated freely whenever called upon.

Milwaukee Public Museum.—However, in most cases the Station has not only taken, but has given as well. Thus, the Station cooperated with the Milwaukee Public Museum in enabling its botanical custodian to prepare a series of lantern slides for public lectures. It has also sent specimens, not only of plants, but of plant products as well. In like manner the Station has co-



DRYING SHED

operated with public and other libraries in placing its reports in places readily available to readers of those libraries.

Dissemination of Information.—The statute establishing the Station also makes it a duty "to disseminate such information as may lead to the proper cultivation of medicinal plants and the production of high grade vegetable drugs in this state." This dissemination of information has by no means been restricted to the state, for requests for information are constantly coming in from practically every section of the country. Unfortunately, most of these requests are based on newspaper articles in which the possibilities of the cultivation of medicinal plants are greatly exaggerated, either ignorantly, or wilfully for the mere sake of striking headlines. In spite of the warnings issued from time to

time by the federal government, get rich quick schemes seem to find ready believers at all times. The Station regards it its duty to save the money of misled prospective investors as well as to assist those who have an understanding of the needs of our materia medica and are seriously striving intelligently and honestly to meet this need.

With Pharmacists.—It is further the duty of the Station to cooperate "with both pharmacists and physicians in securing for the sick the best medicines that pharmaceutical science and art can provide." This form of cooperation has assumed a new phase during the past year in that both the Station's pharmacist and chemist visited a number of drug stores in Madison and Milwaukee in order to get better acquainted with the needs of the pharmacist and to carry the facilities of the Station directly to the centres from which the medicaments are distributed to our sick. This direct contact between the Station staff and the dispensing pharmacist gives great promises for good in the future, hence it is hoped that it may be extended.

With Store Room C.—The supply of absolute alcohol for all departments of the University was undertaken through the agency of the Chemical Supply Room and a relatively very large saving effected for the State. Various grades of petroleum hydrocarbon fractions, such as petroleum ether, etc., were repeatedly distilled from gasolin. Animal charcoal was also made. The production of certain chemicals and the recovery of chemicals from laboratory waste affords a large field for work which ought to receive proper attention. Most of the work thus far attempted was done by or under the direction of Mr. Richtmann or Dr. Nellie Wakeman.

ECONOMIC EXPERIMENTS

It has already been pointed out that, at the request of the Office of Drug-Plant and Poisonous-Plant Investigations, the Board of Regents assigned the so-called "Olin forty" for the new Pharmaceutical Garden. Hence, the first step to be taken was to plan several acre experiments in order that the economic aspects of drug cultivation might be better understood. It is one thing to have a medicinal plant garden that will prove useful for in-

structional purposes, but the problems that arise with the cultivation of medicinal plants for commercial purposes are quite distinct. Even the cultivation of one one-hundreth of an acre or of five, or ten one-hundreths, as tried out in the old garden, does not bring out adequately the problems of drug farming on an economic scale. With an entire acre devoted to a single species, the problems that arise practically necessitate a revolution of methods. To illustrate this point, two experiences may be described briefly.

Belladonna.—Thus, e. g. in connection with the belladonna crop of the summer of 1917, the Station had its first real collecting, drying, and milling problems to solve. The collecting of individual leaves had to be abandoned at least toward the end of the season. The old drug drying tray was replaced by the tobacco method of drying. In order to effect a separation of leaves, petioles, stems and fruits, mechanical methods and means had to be devised. The milling of the products gave the Station its first opportunity to experiment on a technological scale. The leaf product, more than three hundred pounds of No. 60 powder, which was much purer than demanded by the U. S. Pharmacopoeia, was a result of which any drug farmer and miller might well be proud. It assayed 0.315 p. c. of alkaloid, whereas the U. S. P. requirement is 0.30 p. c.

Peppermint.—The second illustration, which revealed the importance of acre experimentation along very different lines, is peppermint. In this case, the plant is not cured to a drug, but its so-called quintessence is extracted by steam distillation in the form of a volatile oil of peppermint. It is the common practice to discard the water soluble portion of the distillate. An examination of this aqueous distillate, however, revealed that it contained about 10 p. c. of the volatile oil and, what is more, a liter of water soluble organic substances. Inasmuch as the peppermint herb distilled was first year's growth, it is to be expected that the second year's crop might yield again as much oil and water soluble materials per acre. Translated into the practice of a thousand acre peppermint farm, such as are found in Michigan, this means that we have been throwing away from one to two thousand liters (two to four thousand pounds) of such organic chemicals for each of these large farms. Whether the saving of these products is economically practicable, remains to be seen. However, this acre experiment for the first time brought

Preparing and marking ground for, and dropping roots of *Mentha piperita* L. Wisconsin Pharmaceutical Garden 1917.

1 acre of *Mentha piperita* L. Wisconsin Pharmaceutical Garden 1917.

Still used in distilling oil from *Mentha piperita* L.

out the existence of these by-products, hence the possibility of their economic study. Biochemically, the results are of greatest interest, quite irrespective of any economic or commercial considerations.

WAR WORK

As previously stated, the second consideration that induced the Legislature of 1917 to increase the budget of the Station, was to enable it to assist in supplying a part of the deficiency of good drugs from which the market was suffering. The belladonna experiment, already referred to, is an illustration of this kind of work. Another illustration is afforded by the disposal of the 1917 digitalis crop.

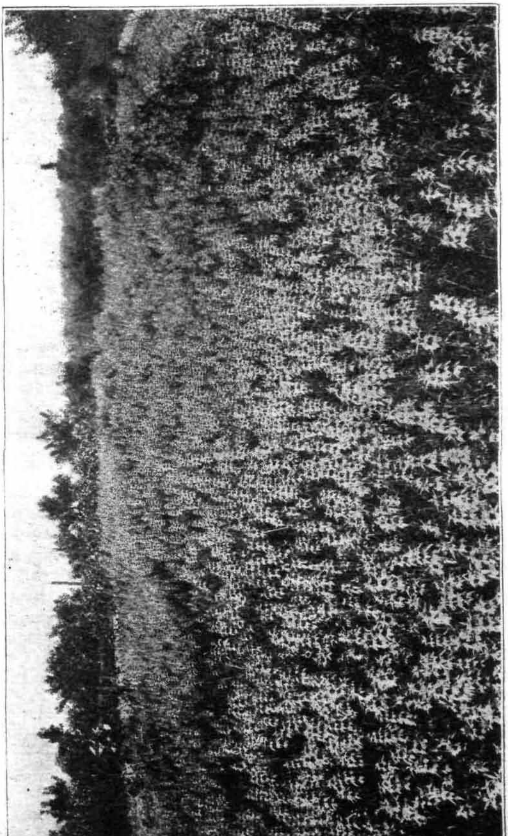
Wisconsin digitalis attracted attention very early in connection with the garden experiments. Its quality proved such, that several eastern hospitals secured their supply from the Station. While filling an order for one of these hospitals, the Station learned how to purify, by mechanical means, this important heart tonic. The method employed was briefly mentioned on page 14 of the Second Report. It has already been adopted by others who are working on a large scale.

With half an acre of choice digitalis as a result of the season's work, the Station, with the consent of the Board of Regents, offered this crop to the Surgeon General of the Army. The offer was accepted, the drug has been purified by milling, and the pure drug converted into tincture by the Pharmacist of the Station. Three thousand one-half pint bottles are required to take care of the product.

MONARDA AND THYMOL

The field activities directed toward the distillation of the volatile oil of *Monarda punctata* L., commonly known as horsemint, or bee balm, have been described in the previous report. As a result of these efforts, a hundred pounds or more of thymol were produced. Among the by-products, the presence of carvacrol, an isomer of thymol, was demonstrated[2] in the noncrystallizable

[2]Nellie Wakeman, unpublished results.



Monanda Field, at Highlands, 1918.

phenol, thus supplying the explanation why the oils never yielded as much thymol as the assay indicated.

The principal efforts during the past two years, however, were directed to economic problems of an agricultural nature. Whereas no difficulty had been experienced in the raising of Monarda from seedlings germinated in greenhouse, hotbed or cold frame, *out-of-door seeding in the open field had hitherto failed* as a practical method. Various cover crops had been tried, but *none proved successful until winter rye was used in the fall of* 1916. This experiment gave an excellent germination and the plants *thrived when the rye was harvested as the first year's crop.* They wintered well during the season of 1917–18 and in the spring of 1918 a dense field of Monarda resulted. The plants blossomed profusely and were harvested August 5, 1918.

Inasmuch as the summer of 1918 was a poor year for bee food in this section, attention should once more be directed to *Monarda punctata* as a bee food. Although expert entomologists and botanists seem to have known little about this important bee food[3], beekeepers in the valley of the southern Wisconsin River know the plant by the name bee balm and value it highly as an important source of honey.[4] Hence, the cultivation of *Monarda punctata* ought to prove an important factor to beekeepers as well as a source of thymol.

The Monarda Survey, originally made possible by Professor Beal's financial support,[5] was continued by Mr. W. O. Richtmann who, with the aid of his auto, covered a large territory between Madison, La Crosse and Trempealeau, extending his excursions as far as Black River Falls. It is to be hoped that this survey may ultimately be extended over the entire state.

That the importance of this work is being appreciated outside of Wisconsin, has already been pointed out in connection with the establishment of the Fritzsche Brothers Fellowship devoted to the study of Monarda problems and the production of thymol.

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[3] See Pammel, *American Bee Journal*, 1918, p. 55.

[4] See also Bulletin No. 685, U. S. Dept. of Agr., S. A. Jones, *Honey bees and honey production in the U. S.*

[5] See Second Report, p. 31.

PLANT BREEDING

The improvement of alkaloid-bearing plants is a problem of greatest importance, moreover one that requires continued work for a series of years. Hence it is a pleasure to be able to report that the breeding experiments conducted as a cooperative enterprise between the Department of Experimental Breeding of the College of Agriculture and the Station have continued uninterruptedly during the past biennium. Whereas the pharmacognosist of the Station has had charge of the cultivation of the Datura plants, Mr. Woodworth, under Professor Cole's directions, has attended to the breeding proper, and the pharmacist has made hundreds of assays. The results of this joint enterprise may be published as a separate paper before long.

MEDICINAL PLANTS AND DESIGNS

A unique use made of material raised in the Pharmaceutical Garden was alluded to in the Second Report under the title "Medicinal plants in decorative arts" (p. 24). Following up her class work at the local High School, Miss Bernice Oehler prepared, upon request, for *The School Arts Magazine* of Boston an article on this subject that attracted considerable attention in pharmaceutical and medical as well as in school art circles. The *Journal of the American Pharmaceutical Association* republished the plates and otherwise called attention to the possibilities along various lines. In order to show more concretely the application of medicinal plant designs to drug store practice, Miss Oehler prepared a variety of designs and wrote the text of a manuscript on the subject that was published as Circular No. 3. (See Publications.) This also has received favorable comment.

PUBLICATIONS

In order to make effective its obligations to "disseminate . . . information," the Station has thus far published two reports. A biennial report, however, is not the best way to spread information, hence the Station availed itself of the *University Bulletin* to publish some of the results of its investigations. Inasmuch as the character of these bulletins has been changed, the Station has begun the publication of circulars. The card form of disseminating information has also been adopted.

Circulars. As circulars such reports have been published that do not fit in with the new scheme of *University Studies* which have taken the place of the former *Science Bulletin.* Thus far the following circulars have been issued:

1) *Announcement.* By the Director, Oct. 1917.

2) *The Volatile Oil of Pycnanthemum lanceolatum.* By E. R. Miller, April 1918.

3) *Medicinal Plants and Designs.* By Bernice Oehler, June 1918.

4) *The Volatile Oil of Monarda fistulosa.* By E. R. Miller, November 1918.

5) *Petroxolins and Parallel Preparations.* By H. A. Langenhan and G. J. Noel, December 1918.

These circulars are being sent only to such pharmacists of the state as have expressed a desire to receive them; upon application also to others specially interested. Unfortunately, the state printer has been unable to see these circulars through the press as rapidly as seems desirable. Because of war conditions, a number of manuscripts are still awaiting publication.

Cards. In answer to inquiries, information has been sent to individuals that ought to prove valuable to pharmacists generally. In this connection, a card system of information of an encyclopaedic-dictionary type has been worked out. (See p. 21 of First Report). Two cards have thus far been issued as such. Others have been published in a preliminary way as fillers in connection with the circulars. Their final publication as cards in the immediate future is contemplated. The following cards have either been published or are in type:

Form 1. Anaesthesin.

Form 2. Drug. Definition in U. S. Federal and State Laws.
Forms 3 to 5. J. O. Schlotterbeck.
Form 6. Liquor Potassii Arsenitis, U. S. P. 1890.
Forms 7 to 28. Petroxolins and parallel preparations.

The importance of the dissemination of information by this method for other than specific station subjects has already been recognized. In order to stimulate such outside activities, Professor James H. Beal of Urbana has contributed the sum of one hundred dollars in order that a beginning might be made. This accounts for four of the titles enumerated above: the three biographical titles and the historical standard. It seems especially desirable for purely practical reasons to push the publication of these older standards at the present time. Hence with the aid of Prof. Beal's fund this activity will be continued.

These cards are not being sent out promiscuously. Copies for library and other purposes can be had upon the payment of a price covering the actual cost.

REPORT OF THE PHARMACOGNOSIST

The writer's connection with the Station as pharmacognosist dates from July 1, 1917. Since Jan. 1, 1918, the supervision of the Pharmaceutical Garden has occupied the greater part of his time. In 1916 the garden at the former location at the southwest corner of Camp Randall was in charge of the Hollister Fellow in Pharmacy and later the Garden Assistant. In 1917 the garden, or more properly gardens for this year, was in charge of the government representative. This year marked the beginning of the change from the old location on Camp Randall to the new location on the Olin forty of the University Farm, near Eagle Heights. Both gardens were operated during 1917. In 1918, owing to the government representative being detailed elsewhere, the pharmacognosist superintended the garden at its new location. The work of growing plants was confined to the new garden in 1918.

Considerable time was necessary to complete the transfer of plants and equipment of the garden from the old to the new location, they being two and a half miles apart. The tool house was moved to the northwest corner of Plot I, and the drying house to near the east center of Plot VII. The permanent and tem-

porary cold frames were located near the timber, north of plots II and III. A 6-inch well, 86 feet deep, was drilled directly east of the cold frames. A double acting force pump, with one and a quarter inch pipe, was installed in the well.

During the spring of 1917 six one acre plots along the south side of the garden were surveyed for the purpose of conducting economic experiments, on at least a semi-commercial scale. Only three of the plots are fully cleared and capable of being cultivated, so in the fall of 1917 all of the acre plots were divided

General View of Plat I, 1918.

into half acre plots. This gives nine one-half acre plots for cultivation of medicinal plants under normal agricultural conditions, and three for propagation under natural shade conditions. Along the north side of the garden five one-quarter plots were surveyed in the fall of 1917.

Each one of the plots has a permanent marker of one inch iron pipe at each corner. The acre plots are 333⅓ feet long and 130⅔ feet wide. The one-half acre plots are 166⅔ feet long and 130⅔ feet wide. The one-fourth acre plots are 83⅓ feet long and 130⅔ feet wide. Adjoining plots are separated by a ten foot strip. All of the one-half acre plots slope toward the south, while the one-quarter acre plots slope toward the north.

When crops are planted in rows on any of the plots, the rows are placed 40 inches apart, giving 100 rows to the full acre, 50 rows to the half acre, and 25 rows to the quarter acre. Each

row accordingly represents one one-hundredth of an acre. The first and last rows are placed 20 inches from the outside borders.

Owing to the topography of the garden the above number of plots of cleared ground represent about one-half of the area adapted to general field cultivation. The remainder of the area falls under two general types, viz., a, Cleared land, but with slopes too steep for general field cultivation; b, Uncleared land, well covered with a heavy growth of hard-wood timber.

Transplanting Digitalis purpurea L. Wisconsin Pharmaceutical Garden 1917.

The larger part of the garden not cultivated at the present time is of the first type. Plans are being developed for the propagation of various kinds of perennial plants of pharmaceutical interest, in groups or beds, on this area. In the wooded area propagation and cultivation of medicinal plants under natural shade conditions, both on fractional acres and in groups or beds, has been started and plans have been made for a marked extension of this work.

In addition to the rather extensive wooded area in the west central part of the garden, the garden is practically surrounded by a wooded border of varying width. The larger part of this

border is natural, with some artificial planting. Neither the wooded area nor the border has been looked after for some time. Considerable dead wood has collected, vines have spread unmolested, and various undesirable plants have obtained a foothold.

A start has been made to change these conditions, especially along the south border, fronting the University Drive going to College Hills. In addition to removing the dead wood, vines and undesirable plants from this border, all growth has been removed from certain areas in order to give a large opening about 50 feet wide at the foot of each plot. In addition to affording attractive

Harvesting first year leaves of *Digitalis purpurea* L. Wisconsin Pharmaceutical Garden 1917.

views of the garden from the Drive, these openings should also give improved circulation of air currents over and through the garden, especially the three westerly plots. Deadwood and undesirable plants are also being removed from the wooded area, and the remaining borders.

On the area actually under cultivation, during the past two seasons, many rocks of various sizes have been encountered. The area had been under cultivation for a number of years before being turned over to the Station, and some of the rocks had been removed. During the past season a special effort has been made to remove as many of these obstructions as possible. The smaller ones were dug out and hauled off as soon as found. The larger ones were dug around and loosened. Through the courtesy of the local representative of the Dupont Powder Co., Mr. H. Mathison.

and Prof. J. H. Sweneheart of the Land Clearing Department of the College of Agriculture, a rock removing demonstration at the garden was arranged. A small but enthusiastic audience witnessed the demonstration. Rocks that were deeply buried were first blown to the surface by a charge of low power (20 per cent) explosive. Several of these rocks were blown a number of feet into the air, and landed as much as 10 feet from the hole. These rocks and the ones lying near the surface were broken by a charge of high power (60 per cent) explosive. In addition

Harvested first year leaves of *Digitalis purpurea* L. Wisconsin Pharmaceutical Garden 1917.

to removing and breaking the rocks, the explosive also broke up the underlying clay sub-soil over a much larger area than that occupied by the rock. The effect of this on subsequent cultivation will be followed with much interest. A total of 14 boulders was removed in this manner, the largest of which measured 6 feet by 4 feet by 4 feet. The broken rocks were removed, and the holes then filled.

During 1917 the following plants were cultivated under commercial conditions:

Botanical name	English name	Area	Part used
Mentha piperita L.	Peppermint	1 acre	Oil
Atropa Belladonna L.	Belladonna	1 acre	Leaves
Hyoscyamus niger L.	Hyoscyamus	½ acre	Leaves
Digitalis purpurea L.	Digitalis	½ acre	Leaves
Artemisia Absinthium L.	Wormwood	¼ acre	Oil

Of these plants, Peppermint, Belladonna and Wormwood ar perennials, while Hyoscyamus and Digitalis are biennials. Whe the areas were planted it was hoped that the plants could b propagated for more than one season.

The winter of 1917–18 was unusually severe in Wisconsin, a well as elsewhere in the United States. Much of the clover i the state was winter killed. Many other plants not normall subject to winter killing were reported to have been destroye by the cold. The plants above mentioned fared but little bette The Wormwood alone suffered but little. The Hyoscyamus suf fered some and nearly all of the Peppermint was destroye Aside from a limited number of plants that survived in the fiel two very limited areas that had received a light mulching suf fered no ill effects from the cold. Every Belladonna and Digi talis plant was killed. This necessitated the propagation o plants during the past season for each one of these plots with th exception of the Wormwood.

During the season of 1918 the following larger areas wer cultivated:

Botanical name	English name	Area	Part used
Atropa Belladonna L.	Belladonna.	1 acre.	Leaves
Hyoscyamus niger L.	Hyoscyamus.	1 acre.	Leaves
Papaver somniferum L.	Poppy	¾ acre.	Seed & Capsules
Monarda punctata L.	Horsemint	¾ acre.	Oil
Artemisia Absinthium L.	Wormwood	½ acre.	Oil
Digitalis purpurea L.	Digitalis	½ acre.	Leaves
Monarda fistulosa L.	Wild Bergamot	½ acre.	Oil
Mentha piperita L.	Peppermint	¼ acre.	Oil

In view of the experience last winter in the winter killing o several of the above plants, especially Belladonna, Digitalis an Peppermint, the effect of mulching with marsh hay will b studied during the coming winter.

A summary of the work of cultivation of medicinal plants a the Station for the seasons of 1916, 1917 and 1918 is given belo For the sake of ready reference the plant names have been a ranged alphabetically. A plus sign after the plant under an year indicates that the plant was cultivated during that yea In the column headed "Off." the designations indicate the fo lowing: a, official in the United States Pharmacopoeia IX, eithe as a part or product of the plant; b, official in the National Fo mulary IV; c, official in both of these books.

LIST OF PLANTS CULTIVATED IN 1916, 1917 and 1918

	Off.	1916	1917	1918
Acorus Calamus L.	..	+	+	+
Alpinia officinarum Hance	b.	..	+	..
Anemone Hepatica L.	..	+	+	+
Anethum graveolens L.	..	..	+	+
Arisaema triphyllum (L.) Torr	..	+	+	+
Artemisia Absinthium L.	b.	+	+	+
Atropa Belladona L.	a.	+	+	+
Bicuculla Cucullaria (L.) Millsp.	b.	+	..	..
Brassica (species)	..	..	+	..
Cannabis sativa L.	a.	+	+	+
Capsicum (species)	..	+	+	+
Capsicum (species) S. P. I. No. 20,066	..	..	..	+
Capsicum annuum L. (Anaheim)	..	..	..	+
Capsicum annuum L. (County fair, Henderson.)	..	..	..	+
Capsicum annuum L. (Hungarian paprika)	..	..	..	+
Capsicum frutescens L. (Japanese chillies, large)	a.	..	..	+
Capsicum frutescens L. (Japanese chillies, small)	a.	..	..	+
Capsicum frutescens L. (Red cayenne, large)	a.	..	..	+
Carthamus tinctorius L.	..	+	+	+
Carum Carvi L.	a.	+	+	+
Celastrus scandens L.	..	+	+	+
Chenopodium ambrosioides anthelminticum L	a.	+	..	+
Chrysanthemum cinerariifolium (Trev.) Bocc.	..	+	..	..
Claviceps purpurea (Fries) Tulasne	a.	..	+	..
Cnicus benedictus L.	..	+	..	+
Coriandrum sativum L.	a.	+	+	+
Cuminum Cyminum L.	..	..	+	..
Curcuma longa L.	..	..	+	..
Cymbopogon citratus Stapf	..	..	+	..
Cymbopogon Martini Stapf	..	..	+	..
Cymbopogon Nardus Rendle	..	..	+	..
Datura (species) A	..	..	..	+
Datura (species) B	..	..	..	+
Datura Stramonium L.	a.	+	+	+
Datura Tatula L.	a.	..	..	+
Delphinium Ajacis L.	b.	..	+	+
Digitalis purpurea L.	a.	+	+	+
Dryopteris marginalis (L.) A. Gray	a.	..	+	+
Echinacea (species)	..	..	..	+
Erigeron canadensis L.	..	+	+	..
Foeniculum vulgare Mill. (French)	a.	..	+	+
Foeniculum vulgare Mill. (Levant)	a.	.	+	+
Gaultheria procumbens L	a.	+	..	..
Geranium maculatum L.	b.	+	+	+
Glycyrrhiza glabra typica Reg. et Herd.	a.	..	+	..
Hedychium coronarium (?)	..	..	+	..
Helianthus annuus L.	..	+	+	+
Humulus Lupulus L.	c.	+	+	..
Hydrastis canadensis L.	a.	+	+	..
Hyoscyamus muticus L.	..	+	+	..
Hyoscyamus niger L.	a.	+	+	+
Iris florentina L.	b.	+	+	+
Iris germanica L.	b.	+	+	+

LIST OF PLANTS CULTIVATED IN 1916, 1917 and 1918—Cont.

	Off.	1916	1917	1918
Iris versicolor L.	b.	+	+	+
Lallemantia iberica (Bieb.) Fisch. et Mayer	..	..	+	+
Lavandula vera DC.	a.	..	..	+
Lavandula Spica Cav.	..	..	..	+
Levisticum officinale Koch	..	+	+	+
Marrubium vulgare L.	..	+	+	+
Matricaria Chamomilla L.	a.	+	+	+
Mentha arvensis var. piperascens Malinvaud	..	+	+	+
Mentha citrata Ehrh.	..	+	..	+
Mentha crispa L.	..	+	+	..
Mentha piperita L.	a.	+	+	+
Mentha viridis L.	a.	+	+	+
Monarda didyma L.	..	+	+	+
Monarda fistulosa L.	..	+	+	+
Monarda punctata L.	..	+	+	+
Nepeta Cataria L.	b.	+	+	+
Ocimum basilicum L.	..	..	..	+
Origanum Majorana. L.	..	..	..	+
Panax quinquefolius L.	..	+	+	..
Papaver somniferum L. (Black seeded)	c.	..	+	+
Papaver somniferum L. (Blue seeded)	c.	..	+	+
Papaver somniferum L. (White Seeded)	c.	+	+	+
Pelargonium odoratissimum Ait.	..	+	+	..
Perilla frutescens (L.) Brit.	..	..	+	+
Phytolacca decandra L.	b.	+	..	+
Pimpinella Anisum L.	a.	+	+	..
Podophyllum peltatum L.	a.	..	+	+
Ptychotis Ajowan DC.	..	..	+	+
Rhamnus Purshiana DC.	a.	+	+	+
Rhus glabra L.	b.	+	+	..
Ricinus communis L.	a.	+	+	+
Ruta graveolens L.	..	..	..	+
Salvia officinalis L.	..	+	+	+
Sanguinaria canadensis L.	a.	+	+	+
Silybum Marianum Gaertn.	..	+	..	..
Tanacetum vulgare L.	..	+	+	+
Urginea maritima (L.) Baker	a.	..	+	..
Valeriana officinalis L.	a.	+	+	+
Vetiveria zizanioides Stapf	..	..	+	..

The harvested crops have been dried under proper conditions either on trays in the drying house at the garden, or in the attic of the Chemistry Building. At the latter place the materials were spread upon the floor, on one inch mesh chicken wire, or suspended from wires strung on supports, depending upon the amount and nature of the material to be dried.

After the material had been thoroughly air-dried, the various products were subjected to various treatments to get them into

marketable or improved condition. In the case of Digitalis leaves it had previously been determined that a large amount of dirt adhered to the hairy surface of the leaf, and that practically all of this dirt could be removed by grinding the leaf to a very coarse powder, and then sifting the powder. Accordingly all of the digitalis grown in 1917 was milled to yield the maximum amount of a No. 10–20 powder instead of a No. 20 powder as had previously been done. The yield of pure powdered leaf was thereby increased from 51½% to 70½%. The portion passing through No. 40, 60 and 80 sieves was reserved for investigation. The portion that passed through a No. 100 sieve was found to be practically nothing but fine dirt. The total quantity of digitalis leaf produced in 1917 was 238 pounds. When handled as above outlined, 166½ pounds of No. 10–20 powder, (70½%), 26 pounds of No. 40–60–80 powder, (10¾%), and 39 pounds of No. 100 powder, (16¼%), were produced. The loss in milling was 6½ pounds (2½%). Hyoscyamus leaves were handled in a similar manner, with practically the same results, only the per cent of dirt was found to be greater. The total quantity of hyoscyamus leaves produced in 1917 was 41½ pounds. When milled as outlined under digitalis leaves 24½ pounds of No. 10–20 powder, (59%), 3¾ pounds of No. 40–60–80 powder, (9%), and 11¾ pounds of No. 100 powder, (28%), resulted. The loss in milling was 1½ pounds (4%). Sage was treated in a similar manner, only producing a coarser powder by hand rubbing. Stems as well as a smaller amount of dirt were removed in this manner.

The portion of the 1917 Belladonna crop, harvesting the entire above ground parts, was subjected to a separation of the different parts, by coarse sieving, in order to determine the relative amounts of coarse stems, small stems, leaf petioles, leaves, and fruit bodies. The results were as follows: leaves 78.1%, leaf petioles, fine stems 1.3%, small stems 4.6%, coarse stems 4.6%, fruit bodies 11.3%. The latter were later broken in order to determine the relative amounts of shells and seeds. The following results were obtained, shells 32%, seeds 60%, and chaff 8%. All of these parts, with the exception of the seeds, were subsequently ground to No. 40 powders for further examination.

The various seed crops were handled, after having been air-

dried according to the requirements of each particular kind. Final cleaning in each case was made with a small Clipper fanning mill.

A considerable amount of thymol, obtained from various sources, but all produced from *Monarda punctata* L. was purified. Not having a centrifuge available for the work, a process was devised in which ordinary percolators were made use of to remove the petroleum ether which was used as a purifying agent. The details of this process are on file with the Director of the Station.

REPORT OF WORK OF THE PHARMACIST

One of the principal duties of the pharmacist would seem to be indicated by the statutory demand upon the Station that it cooperate with the pharmacists of the state in rendering better service to the sick. From the very beginning the Station has offered its cooperation, however, but few have been the requests from pharmacists for professional assistance. Hence, in order to bring the pharmacists of the state into closer touch with the Station, both the chemist and the pharmacist visited a number of drug stores of two cities. All of the minor problems that were presented were solved and the solutions reported to the individuals who had brought up the respective problems. The ready response with which these visits were received has revealed clearly that this phase of cooperation should not only be continued but pushed to the fullest extent possible. If this phase of the pharmacist's Station activity has not been followed up, this seeming neglect has been due, not to any unwillingness on the part of the pharmacist but largely to circumstances over which he has had little or no control. The influenza epidemic among the S. A. T. C. students and the urgent necessity to cooperate with the University Clinic in the preparation of indispensable remedies is one of these causes. It is to be hoped that from now on this work of direct cooperation with the pharmacists of the state may be resumed.

During the biennium covered by this report, as in the past,

the pharmacist has cooperated with the Department of Experimental Breeding of the College of Agriculture, in the cooperative experiment of Datura breeding conducted by the Station at the suggestion of the Office of Drug-Plant and Poisonous-Plant Investigations of the Bureau of Plant Industry. Whereas Mr. Woodworth has carried on the breeding phases of this experiment, the pharmacist, in charge of the alkaloidal assaying, has made the quantitative determinations of total alkaloids in the leaves picked from the experimental plants. During the season 1916, leaves from 175 plants were picked, involving the same number of determinations. During the season 1917, leaves were collected from 95 plants involving no less than the same number of determinations. During the past season, assay material was collected from 155 plants. The determinations will be made as soon as the present rush of work is over.

Inasmuch as the Board of Regents had offered the 1917 digitalis crop to the Surgeon General of the Army, it became the pharmacist's duty to convert the drug, purified by milling, into U. S. P. tincture. This was accomplished and the tincture allowed to age. It required three thousand one-half pint bottles, the size desired by the medical branch of the Army, to take care of this product. Incidentally experiments were made with the other parts of the milled drug not turned over to the Army. All of these products await pharmacological assay in order to be able to interpret properly the work thus far accomplished.

While the Station is more than willing to assist, to the extent of its ability, the individual pharmacist in rendering better service to the sick, it naturally chooses such problems for solution as are of more general interest and import. Such a problem has presented itself in a new class of galenical preparations, the Petroxolins of the N. F. and their numerous parallel preparations. The very fact that no less than twenty parallel preparations have been introduced semi-officially by pharmaceutical organizations in Europe as well as here and by numerous manufacturers reveals without further comment the immediate practical importance of these external preparations, concerning which but little reliable literature may be had. As a matter of fact, very little of this is available to the average pharmacist who may at any moment be confronted with some one or other of the above preparations in his prescription practice.

The subject having been studied experimentally as well as

bibliographically in connection with an undergraduate thesis, the results were presented to the American Pharmaceutical Association and have since been published as Station Circular No. 5. Moreover, the data thus accumulated were of such a nature as to lend themselves particularly to the card form of disseminating information. Hence a card was prepared for each of this type of medicaments. These cards are now ready for distribution.

Incidentally, the pharmacist has also supplied assays of mydriatic drugs to the pharmacognosist.